

Measurements

Your Tasks (Mark these off as you go)

- ☐ Assign group roles
- ☐ Review significant figures in measurements
- ☐ Review how to count significant figures
- ☐ Complete the measurement challenges
- ☐ Receive credit for the group portion of this lab

☐ Assign Group Roles

Before you continue, record your group number, then collaborate with your group and assign each person a role. Each role and a description is provided below.

Project manager (PM)	Leads the team discussion and keeps the team on task and on schedule. Make sure the final lab is submitted.
Recorder (R)	Ensures that all members have correct answers.
Communication Specialist (CS)	Presents answers (or questions) to the class, instructor, or other teams.
Strategic Analyst (SA)	Considers how the team is working and ensures all voices are heard

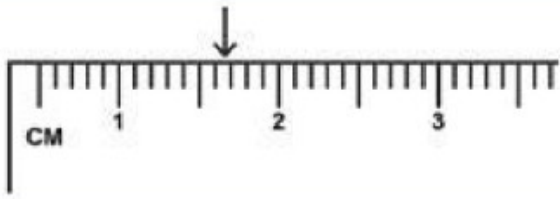
Group Number:	
Name	Role

□ Review significant figures in measurements

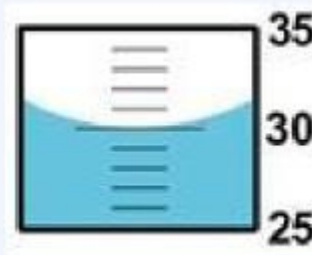
All measuring devices are subject to error, making it impossible to obtain exact measurements.

When recording a measurement, you should record all the digits of the measurement using the markings that you know exactly, plus one further digit that is estimated or uncertain.

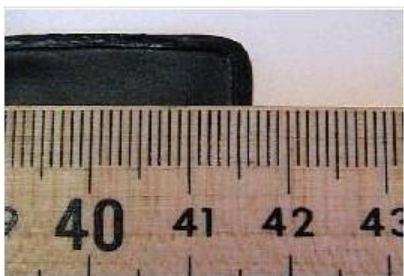
The *uncertain digit* is our best estimate using the smallest unit of measurement given and estimating between two of these values. These digits are collectively referred to as *significant figures*.

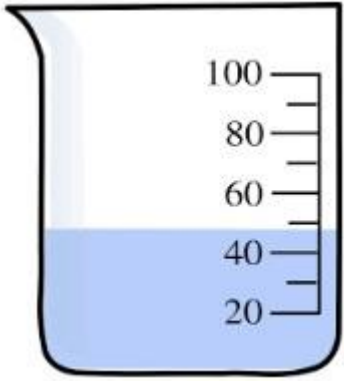
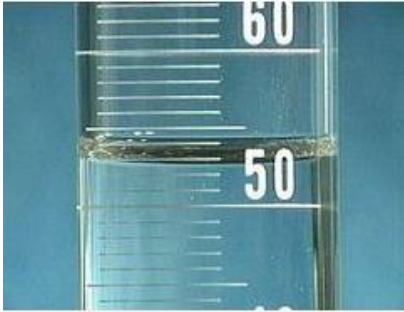
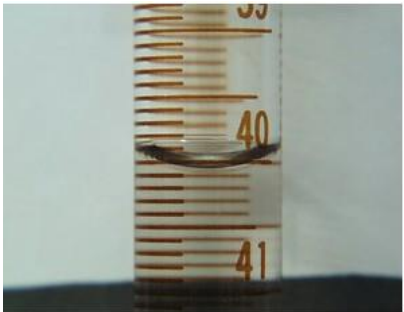

	<p>Here the “ruler” markings are every 0.1-centimeter. The correct reading is 1.67 cm.</p> <p>The first 2 digits 1.6 are known exactly. The last digit 7 is uncertain. You may have instead estimated this measurement as 1.68 cm.</p> <p>The recorded measurement has 3 significant figures. 2 certain plus one estimated.</p>
---	---

The *volume* of a liquid can be directly measured with specialized glassware, typically in units of milliliters (mL) or liters (L). Note that when measuring liquid volumes, it is important to read the graduated scale from the lowest point of the curved surface of the liquid, known as the liquid *meniscus*.

	<p>Here, the graduated cylinder markings are every 1-milliliter. When read from the lowest point of the meniscus, the correct volume reading is 30.0 mL.</p> <p>The first 2 digits 30 are known exactly. The last digit 0 is uncertain. Even though it is a zero, it is significant and must be recorded.</p> <p>The recorded measurement has 3 significant figures. 2 certain plus one estimated.</p>
--	--

Have each person in your group record each of the measurements below. Don't forget to measure to one place of uncertainty AND include units. For each measurement, indicate the number of significant figures. It is OK if you and your partner estimate the last digit differently.

	Partner 1		Partner 2	
	Measurement	Significant Figures	Measurement	Significant Figures
				

				
				
 <p data-bbox="196 1234 565 1297">Be careful! Measure from the top down!</p>				
				

□ Review how to count significant figures

As you saw above, in any measurement, the number of significant figures in a measurement is the number of digits believed to be correct by the person doing the measuring. It includes all the known digits plus one estimated digit.

If you are the person recording the measurement, the number of significant figures is easy to identify. But, what if you are looking at someone else's measurement? The rules for determining the number of significant figures in a measurement are as follows,

Rule	Example
Leading zeros are never significant	000512 has 3 significant figures 0.000512 has 3 significant figures
Trapped zeros are always significant	1001 has 4 significant figures 1.00201 has 6 significant figures
Trailing zeros are significant only if the decimal point is specified	500 has 1 significant figure 10100 has 3 significant figures 100.00 has 5 significant figures

Discuss with your partner the number of significant figures in each of the measurements below. Record the value you both agreed upon.

Measurement	Number of significant figures
124501	
0.00100	
500.00	
300.0100	
500	

□ Complete the measurement challenges

For the remainder of this lab you will practice taking measurements from common laboratory equipment. For each set of measurement challenges

- Navigate to the link provided
- Indicate your first and last name of each lab member
- Take a screen shot of the certificate and paste it in the appropriate box (Both group members need to do this)
- Resize the screen shot as necessary

Challenge	Link	Screen shot of certificate
Ruler Challenge Part 1	http://www.thephysicsaviary.com/Physics/Programs/Games/SimpleRulerUseMS/	
Ruler Challenge Part 2	http://www.thephysicsaviary.com/Physics/Programs/Games/EstimatingRulerUseMS/	

Ruler Challenge Part 3	http://www.thephysicsaviary.com/Physics/Programs/Games/RulerUse/	
Triple Beam Balance Challenge Part 1	http://www.thephysicsaviary.com/Physics/Programs/Games/ReadtheTripleBeam/	
Triple Beam Balance Challenge Part 2	http://www.thephysicsaviary.com/Physics/Programs/Games/ReadtheTripleBeamHard/	
Thermometer Challenge	http://www.thephysicsaviary.com/Physics/Programs/Games/ReadTheThermometerChallenge/	
Graduated Cylinder Challenge Part 1	http://www.thephysicsaviary.com/Physics/Programs/Games/GraduatedCylinder/	
Graduated Cylinder Challenge Part 2	http://www.thephysicsaviary.com/Physics/Programs/Games/SimpleGraduatedCylinderMS/	
Graduated Cylinder Challenge Part 3	http://www.thephysicsaviary.com/Physics/Programs/Games/EstimatingGraduatedCylinderMS/	

□ Receive Credit for this lab

Each group member must complete and submit their own lab to receive credit